ELECTRONIC DEVICE HAVING DISPLAY WITH CURVED EDGES

This application claims the benefit of provisional patent application No. 62/169,453, filed Jun. 1, 2015, which is hereby incorporated by reference herein in its entirety.

BACKGROUND

This relates generally to displays, and, more particularly, to displays with curved edges.

Electronic devices such as cellular telephones, computers, and wristwatch devices often include displays. Display driver circuitry is used to apply control signals to an array of pixels in a display. The array of pixels is used to display images for a user.

Pixel arrays generally have rectangular shapes and include rows and columns of pixels controlled by vertical and horizontal signal lines. Data lines that extend vertically through an array distribute data signals to the pixels. Gate lines that extend horizontally through the array are used to provide control signals to the pixels of each row.

Pixel arrays often have rectangular shapes. However, rectangular pixel arrays will not fit efficiently within a device having a circular shape. Circular displays can have bottleneck regions in which signal lines become crowded, leading to inefficient use of display area.

It would therefore be desirable to be able to provide improved displays such as circular displays or other displays with curved edges.

SUMMARY

An electronic device may have a display. The display may have an array of pixels. The array may have rows and columns of pixels that form an active area for the display. The active area may have a curved edge and may have a circular shape. A circular ring-shaped inactive area may surround the circular active area of the display. Display driver circuitry may overlap the inactive area. For example, curved strips of gate driver circuitry may run along left and right portions of the inactive area.

Display driver circuitry may supply data signals to the pixels using folded vertical data lines. Each folded vertical lines may have a first segment in a left half of the array and a second segment in a right half of the display. Horizontal gate lines may run across the vertical data lines. The horizontal gate lines may be bisected to form left and right isolated segments in each row of the array. The gate driver circuitry may include gate driver circuitry in the left portion of the inactive area that supplies gate line signals to the left segments so that the segments of the folded data lines in the left half of the array can supply data to the pixels in the left half of the array. The gate driver circuitry may also include gate driver circuitry in the right portion of the inactive area that supplies gate lines signals to the right segments so that the segments of the folded data lines in the right half of the array can supply data to the pixels in the right half of the array. Curved coupling segments of the data lines that lie in the inactive area of the display may be used in joining the first and second segments of each data line. Gate driver output buffers may have different strengths in different rows of the array.

An electronic device may have portions that bend or may include flexible printed circuits that are bent. Serpentine lines may be used to convey display signals to and from display driver circuitry in the device. The serpentine lines may overlap a bent portion of a flexible printed circuit or other bent substrate in a display.

Display driver circuits may be provided in top and bottom portions of the inactive area of a display to supply data to respective top and bottom portions of an array of pixels in the display. By spreading out the data line paths between the top and bottom portions of the inactive area, signal line crowding can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of an illustrative electronic device having a display in accordance with an embodiment.

FIG. **2** is a perspective view of an illustrative electronic device having a display in accordance with an embodiment.

FIG. **3** is a perspective view of an illustrative electronic device having a circular display in accordance with an embodiment.

FIG. **4** is a diagram of an illustrative array of pixels for a display in accordance with an embodiment.

FIG. **5** is a top view of an illustrative display in accordance with an embodiment.

FIG. **6** is a top view of an illustrative pattern of gate lines and data lines that may be used in a display in accordance with an embodiment.

FIG. **7** is a top view of another illustrative pattern of gate lines and data lines that may be used in a display in accordance with an embodiment.

FIG. **8** is a top view of an illustrative electronic device having a display in accordance with an embodiment.

FIG. **9** is a perspective view of an illustrative bent substrate having traces that resist cracking in accordance with an embodiment.

FIG. **10** is a top view of an illustrative set of serpentine traces that resist cracking when bent in accordance with an embodiment.

FIG. **11** is a top view of another illustrative set of serpentine traces that resist cracking when bent in accordance with an embodiment.

FIG. **12** is a diagram of illustrative gate driver circuitry in accordance with an embodiment.

FIG. **13** is a diagram of illustrative gate driver circuitry with output buffers that increase in size as a function of increasing row size in a display in accordance with an embodiment.

DETAILED DESCRIPTION

Electronic devices may be provided with displays. The displays may have circular shapes or other shapes with curved edges. A schematic diagram of an illustrative electronic device with a display is shown in FIG. **1**. Device **10** of FIG. **1** may be a computing device such as a laptop computer, a computer monitor containing an embedded computer, a tablet computer, a cellular telephone, a media player, or other handheld or portable electronic device, a smaller device such as a wrist-watch device (e.g., a watch with a wrist strap), a pendant device, a headphone or earpiece device, a device embedded in eyeglasses or other equipment worn on a user's head, or other wearable or miniature device, a television, a computer display that does not contain an embedded computer, a gaming device, a navigation device, an embedded system such as a system in which electronic equipment with a display is mounted in a kiosk or automobile, equipment that implements the functionality of two or more of these devices, or other electronic equipment.